PROJECT facts

U.S. DEPARTMENT OF ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Gasification Technologies

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NOVEL COMPOSITE MEMBRANES FOR HYDROGEN SEPARATION IN GASIFICATION PROCESSES IN VISION 21 ENERGY PLANTS

PRIMARY PARTNER

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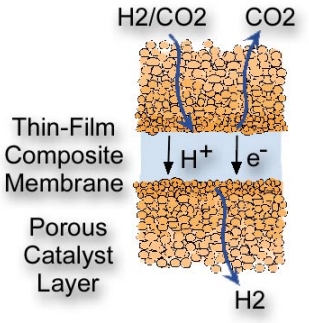
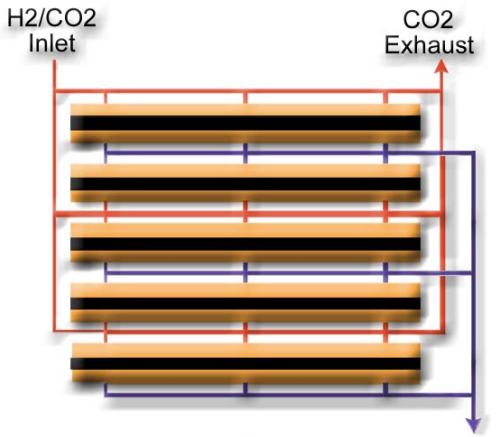
Description

Hydrogen is often considered the fuel of choice for the future. However, separating hydrogen from carbon dioxide during its manufacture is a technical challenge. ITN Energy Systems, Inc. (ITN) is developing composite membranes for the separation of hydrogen from coal gasification streams. In a novel approach, the ITN team will develop a hydrogen separation technology using a monolithic module concept with functionally-graded materials and plasma spray manufacturing techniques.

The Ion Conducting Ceramic Membranes (ICCM) proposed for the separation of hydrogen from hydrogen and carbon dioxide mixtures are 100 percent selective and result in pure hydrogen and carbon dioxide product streams. This selectivity not only delivers hydrogen as a fuel, but also, produces a stream of pure carbon dioxide, a greenhouse gas, for easy capture and sequestration.



Separation of H2 from Gasification Process Stream Using an ICCM Hydrogen Membrane



Monolithic H2 Separation Module

Novel Composite Membranes for Hydrogen Separation in Gasification Processes in Vision 21 Energy Plants

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Goals

The ITN team will develop composite, functionally graded, hydrogen separation membrane modules for applications with coal (or other "opportunity" feedstock) gasification processes, and other concepts in Vision 21 fossil fuel plants. The research focuses on composites fabricated from proton conducting membranes and a second, electron-conducting phase. These composite membranes also serve as functionally graded, porous catalyst layers, thereby enhancing the hydrogen transport rates across the membrane. The goal for this research program is to demonstrate industrially significant hydrogen flux rates of 50 ml/min-cm² in a laboratory-scale prototype in the 600-900 ºC temperature range using thin film design.

Benefits

ITN ICCM technology has several advantages over existing technology for the separation of hydrogen from coal gasification streams. These include:

1. High selectivity for proton conduction resulting in a pure hydrogen stream and a concentrated, high pressure carbon dioxide stream ready for sequestration or other use.
2. A focus on fundamental engineering materials development resulting in inexpensive and compact monolithic membrane modules.
3. High-temperature operation compatible with the coal gasification process.
4. The overall benefit will be the low cost production of electricity and fuels in an environmentally sound manner.